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NASA Centennial Challenges in Collaboration with Ames Research Center
Marshall Space Flight Center, Alabama 35812

Cube Quest Challenge

Ground Tournaments, Deep Space Derby, and Lunar Derby

Operations and Rules

December 4, 2014
Revision B, April 10, 2015

DOCUMENT HISTORY LOG

Status (Baseline/ Revision/ Canceled)	Document Revision	Effective Date	Description
Baseline		11/13/2014	Document Baseline
Revision	A	12/04/2014	Rule 1 clarification. Reference documents revised.
Revision	B	April 10, 2015	Revised Section 1.1 Definitions; Rules 1.B; 2.B; 3; and Section 5.2 Method.

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1.0 INTRODUCTION

The Centennial Challenges Program (CCP) is NASA's flagship program for technology prize competitions (www.nasa.gov/Challenges). The program directly engages the public, academia, and industry in open prize competitions to stimulate innovation in technologies that have benefit to NASA and the nation. The CCP is an integral part of NASA's Space Technology Mission Directorate (STMD), which is innovating, developing, testing, and flying hardware for use in NASA's future missions. For more information about NASA's STMD, visit: http://www.nasa.gov/spacetech.

Beginning in 2015, NASA CCP plans to conduct the Cube Quest Challenge. After a series of Ground Tournaments (GTs), qualified Competitor Teams may be offered a secondary payload opportunity on NASA's first Exploration Mission (EM-1), planned for 2018. All EM-1 Secondary Payload integration costs will be provided by Exploration Systems Development (ESD) for payloads selected. Secondary payloads will be inserted into a trans-lunar trajectory for in-space Challenge purposes. Competitor Teams may also select a third-party launch provider in order to participate in this Challenge. The Deep Space Derby will be conducted once Competitor Team CubeSats have achieved, and maintain, a range of at least 4 million kilometers from Earth. The Lunar Derby will be conducted once a Competitor Team's CubeSat successfully achieves, and maintains, a verifiable lunar orbit as defined in these Rules. Prizes will be awarded for various communications, navigation and longevity achievements that are performed under the conditions of these Rules.

1.1 Definitions

The following terms will be used in conjunction with and for the purposes of the Cube Quest Challenge.

A "**competition day**" is defined as a 24 hour period that starts at the respective time the Competitor Team receives confirmation from their launch service provider of deployment from their respective CubeSat dispenser (regardless of whether deployed from EM-1 SLS or from a Competitor Team-arranged launch vehicle). Each Competitor Team will have their own start time at which their competition days begin counting.

A **Competitor Team** is defined as any combination of one or more Team Members.

A "**data block**" is 1024 bits of random data generated by a NASA-provided algorithm as prescribed by NASA.

An **Entity** is a private or publically owned company, private or publicly owned corporation, college, or university.

"**Error free data**" and "**volume of error free data**" are determined by the number of unique (nonduplicative), whole data blocks delivered to the judges that are free of transmission errors. Competitors may employ any error correction protocols (FEC, ARQ, hybrids) of their choice to achieve error-free data delivery.

In-Space Prizes is the all-inclusive term to refer to the Prizes available in the Deep Space Derby and the Lunar Derby.

Judges is the five member panel that assesses and scores entries during Ground Tournaments, and hold the final determination of prize award winners.

An "**operating period**" is a continuous 30-minute time segment during which the Competitor Teams will officially attempt to receive data.

Prizes is the all –inclusive term to refer to the monetary amounts awarded during the Ground Tournaments, Deep Space Derby, and Lunar Derby.

A **Team Member** is an individual or Entity who is currently contributing to a CubeSat, or who is providing ground station communication services, launch services or other services at rates not available to other customers, for a CubeSat competing in the Cube Quest Challenge. Team Members may be associated with more than one Competitor Team. If a Team Member is an individual, the individual has to be a citizen or permanent resident of the United States. If the Team Member is an Entity, the Entity must be a U.S. Entity.

A **Team Leader** is a Team Member acknowledged or designated by the Competitor Team as the leader or Cube Quest Challenge point of contact. The Team Leader must be a U.S. citizen, permanent resident, or U.S. Entity to be eligible to win Challenge Prizes.

A **United States (U.S.) Entity** is an Entity incorporated, chartered, or organized in the U.S. and maintains a primary place of business in the U.S.

2.0 APPLICABLE AND REFERENCE DOCUMENTS

The documents listed in this section are referenced in Sections 3.0 or 4.0 of this document. This section does not include documents cited in other sections of this document, recommended for additional information, or recommended as examples. While every effort has been made to ensure the completeness of these lists, document users are cautioned that they must meet all specified requirements of documents cited in Sections 3.0 or 4.0 of this document, whether or not they are listed here.

Document revisions are current to the date of this publication. Unless specifically noted within the document, the most recent document revision shall be applicable. Document users are responsible to verify correct versions.

The NASA Centennial Challenges website will be the primary location for document(s) access and updates. Hardcopy versions will not be available, except for inhibiting circumstances.

2.1 Government Publications

Government specifications, standards, and handbooks in Table 2-1 form a part of this document to the extent specified herein. The government reference documents are listed in Table 2-2.

Table 2-1 – Government Applicable Documents

Document #	Document name	Date	Revision
SLS-SPIE-HDBK-005	SLS Secondary Payload User's Guide (SPUG)	To be made available at a later date	
TBD	SLS Secondary Payload Safety Check Sheet	To be made available at a later date	
SLS-SPIE-RQMT-018	SLS Secondary Payload Deployment System, Interface Definition Requirements Document (IDRD) (Note: ITAR)	To be made available at a later date	
TBD	Required Data for Competitor Teams with Non-NASA Launch	To be made available at a later date	
TBD	Required Navigation Artifacts for Authenticating Claimed Communication Distances and Verifying Achievement and Maintenance of Lunar Orbit	To be made available at a later date	
TBD	Ground Tournament Submittal Requirements and Standardized Judging Criteria (aka "Judges Score Card")	To be made available at a later date	
CCP-CQ-COMPRO-001	Communications Procedure for Both In-Space Challenges (CommsProc)	11/10/2014	
CCP-CQ-SCHED-	Cube Quest Challenge Schedule	11/10/2014	

001			
NPR 8020.12D	Planetary Protection Provisions for Robotic Extraterrestrial Missions		

Table 2-2 – Government Reference Documents

Document #	Document Name	Date	Revision
NPR 8020.12	Planetary Protection Provisions for Robotic Extraterrestrial Missions	04/20/2011	D
NASA STD 8719.14	NASA Technical Standard, Process for Limiting Orbital Debris	05/25/2012	A
FCC Public Notice DA: 13-445	Rules and Regulations, Title 47, of the Code of Federal Regulations. FCC Public Notice DA: 13-445 (http://www.fcc.gov/document/guidance-obtaining-licenses-small-satellites)		

2.2 Non-Government Publications

The non-government specifications, standards, and handbooks in Table 2-3 form a part of this document to the extent specified herein. The non-government reference documents are listed in Table 2-4.

Table 2-3 – Non-Government Applicable Documents

Document #	Document Name	Date	Revision

Table 2-4 – Non-Government Reference Documents

Document #	Document Name	Date	Revision
	SLS EM-1 Dispenser Information: http://www.planetarysystemscorp.com/?post_type=product&p=448		

3.0 CHALLENGE OVERVIEW

The Cube Quest Challenge is designed to foster innovations in small spacecraft propulsion and communications techniques. Up to a total of $1,500,000 in cash prizes will be awarded to and shared between registered Competitor Teams that meet or exceed technical objectives for communication from at least 4,000,000 kilometers from Earth during the Deep Space Derby. Up to a total of $3,000,000 in cash prizes will be awarded to and shared between registered Competitor Teams that are able to meet or exceed technical objectives for propulsion and communication from lunar orbit during the Lunar Derby. Specific requirements are defined in Section 4.

A series of four Ground Tournaments (GTs) will be conducted prior to both the Deep Space Derby and Lunar Derby. Any registered Competitor Teams – regardless of whether they intend to compete for launch on EM-1 or obtain their own launch – may participate in any or all of the GTs. Up to a total of $1,000,000 in cash prizes will be available in the complete GT series.

Competitor Teams that successfully compete in at least GT4, and declare their intention to launch on EM-1, are eligible for selection to integrate, launch, and be deployed from EM-1 for in-space Challenges purposes.

Competitor Teams may utilize more than one CubeSat for either or both in-space Prizes, but the combined payload volume and mass must be no larger than the equivalent of one 6U volume and mass, and must be deployed from a single 6U dispenser.

Start dates for the In-space Prizes begin at the deployment time from the respective launch vehicles. In-space Prize activity ends for each Competitor Team 365 calendar days after their respective CubeSat space deployment date, regardless of the launch vehicle used, but is no later than 365 calendar days after the EM-1 CubeSat deployment date – whichever occurs first. The results of all Competitor Teams will be considered at the end of the in-space Prizes to determine the winner(s). Data transmissions outside of the 365 calendar days will only be considered for the longevity prizes, regardless of burst rate and volume. No transmissions after Cube Quest Challenge conclusion (EM-1 plus 365 calendar days) will be considered for any prize.

All Competitors will be judged using the same criteria in the Ground Tournaments and In-space Prizes, regardless of the launch vehicle used.

If for any reason the Cube Quest Challenge payload integration, launch, and deployment on the EM-1 mission cannot take place as planned, the NASA Centennial Challenge Program will investigate alternative launch opportunities. If no reasonable alternatives are found to be available, NASA reserves the right to postpone, modify, or cancel the in-space portion of the Challenge.

3.1 Judges and Judging

The Centennial Challenge Program will nominate a panel of five Judges. Judges will be involved in every aspect of the Ground Tournaments and the Deep Space and Lunar Derbies (though individual persons may be assigned as replacements on occasion, as availability or needs arise).

Judges are the final arbiters in the interpretation and enforcement of the Challenge Rules. Judges award all Competitor Team scores and declare prize winners in accordance with the

Rules. Judges are the points of contact for receiving specified data and information from Competitor Teams during the Challenge. Judges may relay technical data to NASA subject matter experts (SMEs) and may consult with NASA SMEs for technical analyses and assessments, but Judges are independent and are given ultimate responsibility by the Centennial Challenge Program for final scores and rulings. Judges are the official points of contact for delivering scores and Rules arbitration to Competitor Teams.

3.2 Competition Phases

The Cube Quest Challenge is conducted in two phases: the Ground Tournaments (GT1 thru GT4), followed by the Deep Space Derby and Lunar Derby (collective referred to as "the In-space Prizes"). Figure 3.1 illustrates Challenge phases and a notional schedule.

3.2.1 Prize Payment

The Centennial Challenges Program Office will issue prize payments within 60 calendar days after Judges announce the winning Competitor Teams. Payments will be made by electronic funds transfer to the individual who is designated on the Registration Data Package as Team Leader (see Section 5.3) for the winning Competitor Teams. Each Team Member shall be aware that NASA is obligated to make Prize payments only to the designated Team Leader. Each Team Member shall also be aware that any failure of the designated Team Leader to make payments of any kind to Team Members is the responsibility of the Team Leader, and not the responsibility of NASA.

3.2.2 Ground Tournaments

The Ground Tournaments (GTs) are a series of four ground-based activities and reviews, based on tests, engineering data, and analyses supplied by Competitor Teams. The GTs allow NASA to gain insight into Competitor Team's spacecraft and mission designs; to assess technical progress, and to evaluate the likelihood of achieving Challenge goals based on standardized assessments; to confirm design compliance with Space Launch System (SLS) and Challenge requirements; and to incentivize progress with intermediate prize awards.

A panel of Centennial Challenge-appointed Judges will review the submitted material. Judges may consult with NASA SMEs, but Judges are the final arbiters for assessments of compliance with Rules and of scores in accordance with the Rules. Judging criteria and expected design maturity progressively advance for each successive GT review. All Competitor Teams are judged by the same standardized criteria. After each GT, the Judges will provide Competitors numeric scores based on the standardized assessment criteria in two categories: 1) design maturity and likelihood of achieving Challenge goals; and 2) compliance with documented Challenge Rules and documented EM-1 safety and interface requirements. Scores will be based on a scale from 1 (low, poor) to 5 (high, superb). Competitor Team composite scores may be posted on the Challenge website after each GT.

Any Competitor Team registered for the Deep Space Derby or the Lunar Derby (or both) may participate in any or all of the GTs. Competitor Teams seeking a NASA launch opportunity on EM-1 must participate in at least the final GT (GT4) in order to be considered for EM-1 integration.

GTs schedule will be published in a separate Cube Quest Challenge schedule, or on the Challenge website or both. Currently, the GTs are planned at approximately 4-6 month intervals, concluding with a planned EM-1 payload delivery date.

NASA will award the prizes for the GTs as described in Table 3.1.

Table 3-1 – Ground Tournament Awards – Preceding the In-Space Challenges.

COMPETITION	PRIZES
GT1	The Five Highest Scoring Competitor Teams with scores greater than 3 will each be awarded $20,000.
GT2	The Five Highest Scoring Competitor Teams with scores greater than 3 will each be awarded $30,000.
GT3	The Five Highest Scoring Competitor Teams with scores greater than 3 will each be awarded $30,000.
GT4	The Five Highest Scoring Competitor Teams with scores greater than 3 will each be awarded $20,000.

The maximum that any one Competitor Team could receive during the GTs is $100,000.

3.2.3 In-Space Prizes

Judges will declare winners in accordance with the Rules. NASA will award the prizes for In-space Prizes as described in Table 3.2. A Competitor Team may only be awarded first or second in any prize, but not both. For example, Competitor Team A may have the fastest data burst rate and the second largest aggregate data volume. Competitor Team A would be awarded first place in the burst rate category and second place in the aggregate data category. Another example, Competitor Team B had the fastest burst rate on two separate transmissions. Competitor Team B will only be awarded first place in the burst rate category leaving the opportunity for second place for another Competitor Team.

Table 3-2 – In-Space Prize Awards

COMPETITION	PRIZES
Deep Space Derby Prizes	Total Available: $1,500,000 • Best Burst Data Rate: $250,000 • Largest Aggregate Data Volume Sustained Over Time: $750,000 • Spacecraft Longevity: $250,000 • Farthest Communication Distance From Earth: $250,000
Lunar Derby Prizes	Total Available: $3,000,000 • Achieve Lunar Orbit: $1,500,000 (shared) • Best Burst Data Rate: $250,000 • Largest Aggregate Data Volume Sustained Over Time: $750,000 • Spacecraft Longevity: $500,000

3.2.3.1 Deep Space Derby Prizes

Judges must verify that competing CubeSats have reached the minimum required distance from Earth (4,000,000 kilometers, as defined in the Rules). While maintaining at least this

distance for prize eligibility, Competitor Teams will perform communications and longevity achievements.

Judges score Competitor Team performances and NASA will award the following Deep Space Derby Prizes (details and constraints are given in the Rules):

1. **Best Burst Data Rate:** $225,000 will be awarded to the Competitor Team that receives the largest, and $25,000 will be awarded to the Competitor Team that receives the second largest volume of error-free data from their CubeSat over a 30-minute period.
2. **Largest Aggregate Data Volume Sustained Over Time:** $675,000 will be awarded to the Competitor Team that receives the largest, and $75,000 will be awarded to the Competitor Team that receives the second largest, cumulative volume of error free data from their CubeSat over a continuous 28-day (calendar days) period.
3. **Spacecraft Longevity:** $225,000 will be awarded to the Competitor Team with the longest elapsed number of calendar days, and $25,000 will be awarded to the Competitor Team with the second longest elapsed number of calendar days between the first and the last confirmed reception of data from their CubeSat.
4. **Farthest Communication Distance from Earth:** $225,000 will be awarded to the Competitor Team that receives at least one, error-free, CubeSat generated data block from the greatest distance and $25,000 will be awarded to the Competitor Team with the second greatest distance. Distance must also meet minimum Challenge requirement.

3.2.3.2 Lunar Derby Prizes

Judges verify that competing CubeSats first achieve a verifiable lunar orbit (as defined in the Rules) to win an equal share of the Lunar Derby Prize. While maintaining a verifiable lunar orbit, Competitor Teams will acquire as much error-free data from their CubeSat within single continuous 30-minute periods, and as much error-free data within any 28-day (calendar day) period.

Judges score Competitor Team performances according to the Rules. NASA will award the following Lunar Derby Prizes (refer to the Rules for details and constraints):

1. **Lunar Propulsion:** $1,500,000 will be divided equally between all Competitor Teams that achieve at least one verifiable lunar orbit, with a maximum of $1,000,000 to any one Competitor Team.
2. **Best Burst Data Rate:** $225,000 will be awarded to the Competitor Team that receives the largest, and $25,000 will be awarded to the Competitor Team that receives the second largest, cumulative volume of error-free data from their CubeSat over a 30-minute period.
3. **Largest Aggregate Data Volume Sustained Over Time:** $675,000 will be awarded to the Competitor Team that receives the largest, and $75,000 will be awarded to the Competitor Team that receives the second largest, cumulative volume of error free data from their CubeSat over a contiguous 28-day (calendar) period.
4. **Spacecraft Longevity:** $450,000 will be awarded to the Competitor Team that achieves the longest elapsed number of calendar days, and $50,000 will be awarded to the Competitor Team that achieves the second longest elapsed number of calendar days, between the first and last confirmed reception of data from their CubeSat.

3.3 CubeSat Payload Delivery, Integration, and Launch

The EM-1 payload delivery, integration, and launch dates will be published in a separate Cube Quest Challenge schedule and/or on the Challenge website.

Currently, the planned EM-1 payload integration may take place as early as EM-1 Launch-1 year. No access to the CubeSats will be allowed after integration. CubeSats will be inactive until a required delay after deployment from the dispensers on EM-1. CubeSat integration and operations requirements can be found in the Space Launch System (SLS) Secondary Payload Deployment System Interface Definition Requirements Document.

If any reason the EM-1 mission cannot take place as planned, NASA will investigate alternative launch opportunities. If no reasonable alternative is identified, NASA reserves the right to postpone, modify, or cancel the in-space portion of the Challenge.

3.4 NASA-Furnished Resources

NASA will provide the following resources at no cost to registered Competitor Teams in addition to the documents identified in Section 2:

- 6U Form Factor guidance
- 6U dispensers for CubeSats selected for EM-1 launch

NASA will provide contact information for a Secondary Payloads Integration Manager (SPIM) to Competitor Teams competing in the Ground Tournaments.

3.5 Example Challenge Scenario

Figure 3.1 illustrates one potential scenario for the two competition phases. Competitor Teams A, B, and D participated in all GTs, while Competitor Team C chose to participate after GT2. Competitor Teams A, C, and D received a score of at least 3 (out of 5) in GT4 and were in compliance with all Challenge requirements including the SLS Secondary Payload Deployment System Interface Definition Requirements Document, and so are qualified for EM-1 flight. Competitor Team B did not pass GT4 (score less than 3), so was not eligible to launch on EM-1.

Competitor Team X participated in GTs 2 and 3 and so is eligible for those respective prizes. However, Competitor Team X did not participate in GT4 thus is not eligible to launch on EM-1. Competitor Team X elected to procure their own launch and to participate in the In-space Prizes. Competitor Teams Y and Z did not participate in any GTs. These Competitor Teams were successfully launched by their third party providers. They conducted communications tests within their respective eligibility windows and were eligible for Challenge awards. Competitor Team Z started their tests less than 28 calendar days from the end of the competition so they had fewer days to collect data than the other Competitor Teams.

For each Competitor Team, the In-space Prizes begin at the time they are deployed in space by their respective launch provider as specified in the In-space Prizes Rules. For Competitor Teams that have arranged their own third party launch, competitions end 365 calendar days after they are deployed by their respective launch provider, or 365 calendar days after EM-1 has deployed the first of the EM-1 CubeSats, whichever occurs first. The only exception would be entries for the longevity categories. Data received after the 365 calendar days (only for third party launched Competitor Teams) will only be considered for longevity verification regardless

of data burst rate or data volume. Any data received after the Cube Quest Challenge conclusion will not be considered for any Prize.

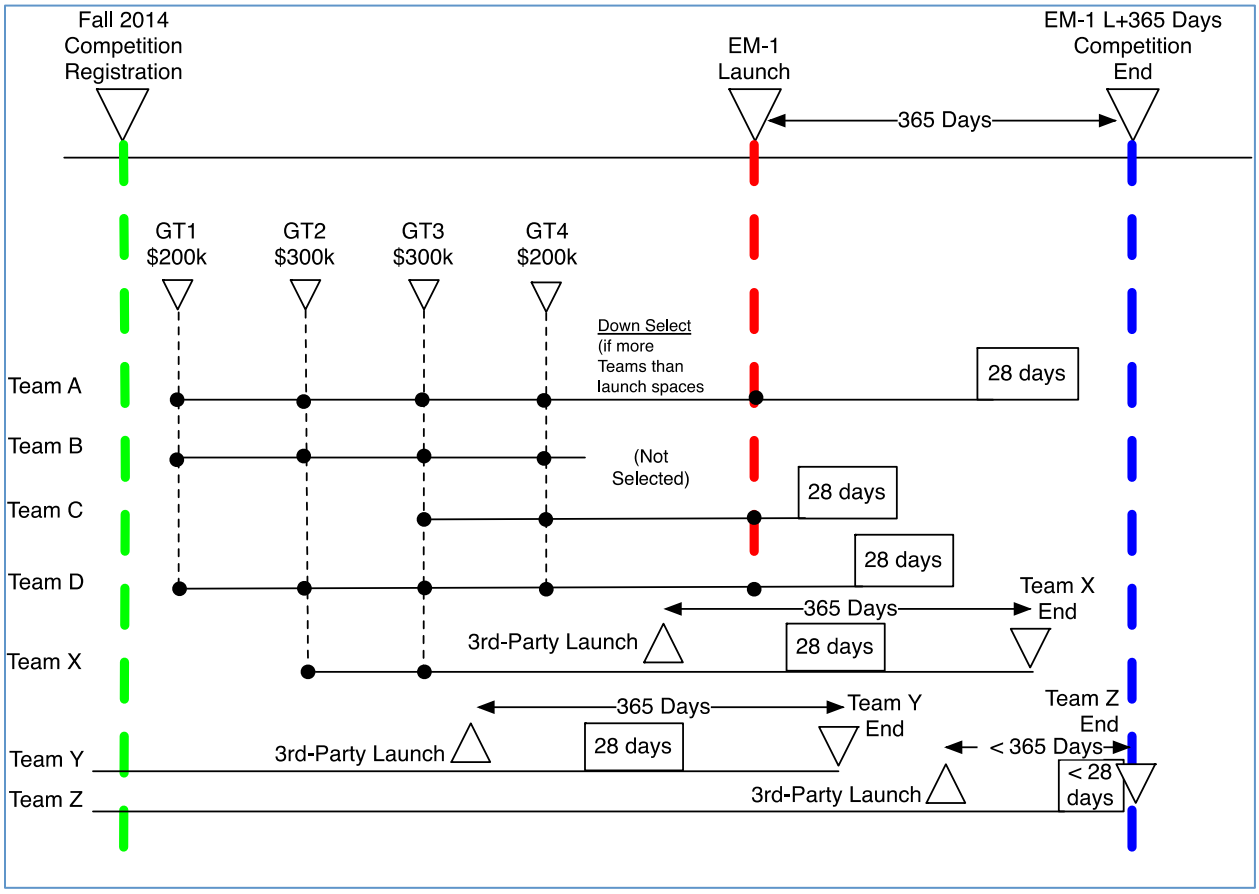

Figure 3-1 Cube Quest Challenge Schedule Depicting Hypothetical Competitor Teams

4.0 COMPETITION REQUIREMENTS AND RULES

Competitors are responsible for understanding and compliance with the Ground Tournament (GT) Rules, the requirements of the SLS Secondary Payload Deployment System Interface Definition Requirements Document (IDRD), and with (when applicable) the Deep Space Derby Rules and/or the Lunar Derby Rules.

The Centennial Challenges Program Office will issue prize payments to the Team Leader(s) within 60 calendar days after the announcement of the winner(s) as determined by the Judges.

4.1 Eligibility and Registration

Rule 1: Eligibility to Compete and win prize(s)

Rule 1.A: In order to be eligible to win a Prize, the Team Leader must be (i) a citizen or permanent resident of the United States, or (ii) an Entity that is incorporated in and maintains a primary place of business in the United States. Competitor Teams must furnish proof of eligibility (including proof of citizenship or permanent resident status, for Team Leader, and proof of incorporation and primary place of business, for an U.S. Entity) that is satisfactory to NASA in its sole discretion. A Competitor Team's failure to comply with any aspect of the foregoing requirements shall result in the Competitor Team being disqualified from winning a Prize from NASA.

Rule 1.B: A Competitor Team is comprised of one or more Team Members. A Team Member can be an individual or an Entity. If a Team Member is an individual, the individual has to be a citizen or permanent resident of the United States. If the Team Member is an Entity, the Entity must be a U.S. Entity (incorporated in and maintains a primary place of business in the United States). Foreign nationals may own up to 49% of an otherwise eligible U.S. Entity. Foreign nationals may only participate as either owners, employees, or students of an otherwise eligible U.S. entity.

Rule 1.C: No Team Member shall be citizens of a country on the NASA Export Control Program list of designated countries. (The current list of designated countries can be found at http://oiir.hq.nasa.gov/nasaecp/).

Rule 1.D: A Federal Entity or Federal Employee may not participate in the Cube Quest Challenge if acting within the scope of their employment.

Rule 1.E: An Entity Employee, or Entity, contracted by the US. Government and physically located at a Federally Owned Facility may not participate if acting within the scope of the contract.

Rule 1.F: Each Team Member shall acknowledge by their signature in the Registration Data Package that NASA shall make Prize payments to the Team Leader, also indicated in the Registration Data Package. Any failure of the indicated Team Leader to make payments of any kind to Team Members is the responsibility of the Team Leader and not the responsibility of NASA.

Rule 1.G: A Competitor Team may only submit a single CubeSat into competition to win a Cube Quest Challenge Prize; however, a Team Member may support more than one Competitor Team.

Rule 2: Competitor Team Responsibilities and Agreements

Rule 2.A: Competitor Teams are responsible for compliance with all applicable regulations and laws including obtaining any necessary approvals for foreign student or employee participation.

Rule 2.B: Prospective Competitor Teams shall submit their notice of intention to compete, and a Registration Data Package (defined in Section 5.0), to the Email address given in Section 5.2. In addition, Competitor Teams must submit a Mission Concept Registration Data Package, as defined in Rule 3, within 60 calendar days after their registration. The prospective Competitor Team will receive a formal acknowledgement receipt of their package within 5 business days of submittal and a formal acceptance as Challenge Competitor Teams within 15 business days.

Rule 2.C: Liability insurance – All Team members agree to assume any and all risks and waive claims against the Federal Government and its related Entities, except in the case of willful misconduct, for any injury, death, damage, or loss of property, revenue, or profits, whether direct, indirect, or consequential, arising from their participation in the competition, whether such injury, death, damage, or loss arises through negligence or otherwise. For the purposes of this paragraph, the term `related Entity' means a contractor or subcontractor at any tier, and a supplier, user, customer, cooperating party, grantee, investigator, or detailee.

Team Members must obtain liability insurance or demonstrate financial responsibility, in the amount of $1,000,000 for claims by—

A. A third party for death, bodily injury, or property damage, or loss resulting from an activity carried out in connection with participation in a competition, with the Federal Government named as an additional insured under the registered participant's insurance policy and registered participants agreeing to indemnify the Federal Government against third party claims for damages arising from or related to competition activities; and

B. The Federal Government for damage or loss to Government property resulting from such an activity.

Rule 2.D: Use of NASA Name and Insignia

Competitor Teams may not use the name or insignia of NASA on its hardware and printed materials related to the participation of Competitor Teams in the Challenge without NASA's prior written consent.

Competitor Teams agree that unauthorized use of such names, trademarks, and insignias shall result in elimination from Challenge participation if Competitor Teams continue unauthorized use after being notified to cease and desist by NASA.

Rule 2.E: Compliance with Existing Laws - Competitors will comply with all U.S. laws, regulations and policies, including those relating to export control and nonproliferation, and the laws of relevant state and local jurisdictions that pertain to or govern any activities conducted by Competitors in connection with the Challenge.

Rule 2.F: Reporting - On a monthly basis, Competitor Teams agree to provide NASA with a written total (a single amount) of the following: Competitor Team's incremental and cumulative financial, property (capital), personnel, and any other investments, and/or expenditures (direct or in-kind) made to conduct any and all activities related to or required by participation of the Competitor Team in the Challenge. NASA will not make this information public except in aggregate form for all Competitor Teams competing in the Challenge.

Rule 2.G: Media Rights

The Competitor Team retains all Media Rights related to the story of its participation in the Challenge.

The Competitor Team agrees that NASA will retain all Media Rights related to the story of the Challenge.

Each Team Member agrees to let NASA use the name and likeness of such Team Member (without charge) as may be reasonably required in connection with the media material prepared and distributed by NASA relating in any way to the Challenge.

The Competitor Team agrees to provide NASA reasonable amounts of video footage or access for recording activities related to participation of Competitor Team in the Challenge and the right to use said footage for public affairs and/or educational purposes.

The Competitor Team agrees that its failure to furnish video footage or access for recording purposes based on NASA's reasonable requests may result in the Competitor Team's removal from participation in the Challenge.

Rule 2.H: Purchase and Sales Rights

The Competitor Team agrees that NASA retains the non-exclusive right to purchase from Competitor Team the resultant or derived product, service, or technology used to win the Challenge. This section does not guarantee a purchase of the resultant or derived product, service, or technology and is subject at all times to the parties reaching mutual agreement after the Challenge.

The Competitor Team retains all rights to sell the resultant or derived product, service, or technology used to win the Challenge to whomever they wish, provided they abide by all local, state, and federal laws and regulations regarding the sale and export of technology.

Rule 2.I: Intellectual Property Rights

Notwithstanding anything to the contrary in these rules, NASA claims no intellectual property (IP) rights from the Competitor Team. All trade secrets,

copyrights, patent rights, and software rights will remain with each respective Competitor Team.

To the extent the Competitor Team owns IP resulting from its participation in Challenge, the Competitor Team agrees to negotiate in good faith with NASA for a grant of a nonexclusive, nontransferable, irrevocable, license to practice or have practiced for or on behalf of the United States, the intellectual property throughout the world, at reasonable compensation, if NASA chooses to pursue such a license.

Rule 2.J: Delay, Cancellation or Termination

The Competitor Team acknowledges that circumstances may arise that require the Challenge to be delayed indefinitely or cancelled. Such delay or cancellation, and/or the termination of the challenge, shall be within the full discretion of NASA, and the Competitor Team accepts any risk of damage or loss due to such delay, cancellation, and/or termination.

Rule 3: Competitor Teams shall submit to NASA a Mission Concept Registration Data Package within 60 calendar days after their registration (and 30 calendar days before they may participate in any of the GTs). The Mission Concept Registration Data Package is defined in a separate document (available on the Cube Quest Challenge website). It includes at least the following content:

- Concept of Operations
- Conceptual Mission Design
- Conceptual method for CubeSat disposal
- Satellite Communications Concept

4.2 EM-1 Launch and Schedule

The Ground Tournaments schedule and the EM-1 payload delivery, payload integration, and launch schedules shall be according to a separately published Cube Quest Challenge schedule (CCP-CQ-SCHED-001). Schedule will be published on the Cube Quest Challenge website.

If any reason arises such that payload integration, launch, and deployment on the EM-1 mission cannot take place as planned for the Cube Quest Challenge, NASA will investigate launch alternatives. If no reasonable alternatives are found to be available, NASA reserves the right to postpone, modify, or cancel the in-space portion of the Challenge.

4.2.1 Notification to Competitors of EM-1 Deployment Trajectory

NASA provides updates on the Centennial Challenge Program Cube Quest Challenge website of the planned Helio-centric orbital elements of the Space Launch System (SLS) upper stage after its disposal maneuver.

The final orbital elements of the EM-1 Secondary Payloads will be posted within 24 hours after the actual EM-1 Secondary Payload deployment maneuver.

Competitor Teams deployed from EM-1 SLS upper stage will be notified of confirmation of successful deployment of their CubeSat as soon as possible after the event. This time constitutes the "Start of Competition" as defined in Rule 15.

Competitor Teams may expect notification by the Joint Space Operations Center (JSpOC) of their official Two Line Element (TLE) orbital elements sometime after deployment and after their individual payload has been identified (typically a few business days).

4.3 Design Requirements

Rule 4: CubeSat Mass, Volume, and Interface Requirements

Rule 4.A: To be eligible for NASA EM-1 Launch, the Competitor's CubeSat shall meet all the requirements of the SLS Secondary Payload Deployment System Interface Definition Requirements Document (IDRD). In the event of a conflict between the SLS IDRD and these Competition Rules, the SLS IDRD shall take precedence. The IDRD will be available to Competitor Teams no later than GT2.

Rule 4.B: To be eligible for NASA EM-1 Launch, the Competitor's CubeSat shall meet all the requirements of the SLS Secondary Payload User's Guide (SPUG). The SPUG will be made available on the Challenge web site upon document release (anticipated 01/2015).

Rule 4.C: For both EM-1 and non-EM-1 launches, payloads shall meet 6U size and mass requirements as defined in the latest version of the SLS Secondary Payload User's Guide.

Rule 4.D: A Competitor Team may submit and operate only one single payload, compliant with the 6U volume and mass constraint as specified in the SLS Secondary Payload User's Guide, eligible for Prizes.

Rule 4.E: Competitor Teams with non EM-1 launches shall be responsible for determining, and complying with, their own respective responsibilities and requirements with the third-party launch vehicle provider. NASA will not assist with compliance with third party launch provider requirements.

Rule 4.F: In case of any discrepancy between the volume and mass allowances of Non-EM-1 launch providers and those of the NASA EM-1 launch, the allowances of the SLS Secondary Payload User's Guide and IDRD shall take precedence for Challenges eligibility.

Rule 4.G: Competitor Teams with non-EM-1 launches shall submit a *Required Data for Competitor Teams with Non-NASA Launch* package (defined in a separate document) at least 2 weeks prior to payload integration, and shall allow a Challenge-designated government inspector to verify by inspection, test, or other method of verification, the data it contains.

Rule 5: Radio Frequency Authorization

Rule 5.A: Competitors agree that use of Radio Frequencies (RF) for any purpose, such as spacecraft tracking and control, information (data) transmission to and from the spacecraft, or active sensors, will be in accordance with all U.S.

laws and regulations, and with the International Radio Regulations promulgated by the International Telecommunication Union (ITU). The controlling organization for each CubeSat shall obtain Federal Communications Commission (FCC) radio frequency authorization in accordance with the Rules and Regulations, Title 47, of the Code of Federal Regulations. FCC Public Notice DA: 13-445 (http://www.fcc.gov/document/guidance-obtaining-licenses-small-satellites) is useful in deciding authorization options to consider.

Rule 5.B: For all communications, including communications eligible for these Challenges, any electromagnetic spectrum frequency (e.g., RF, infrared, visible light, etc.) is allowed, subject to all applicable RF licensing and spectrum allocation Rules.

Rule 5.C: Competitors are responsible for obtaining necessary RF operating licenses for both their CubeSat space stations and for all ground stations under their control, and are responsible for abiding by National and International Rules governing radio operators in their operating spectrum.

4.4 Monitoring and Inspections

Rule 6: Competitors shall permit NASA to non-invasively monitor any space-based communication relevant to the Challenges, using NASA's resources without prior notification to the Competitors. This monitoring may be used to verify compliance with the Challenge Rules and may be used to validate Competitor Team's submissions. This monitoring will not be used as a Competitor Team's official entry into competition. Competitor Teams may not use data encryption (other than encryption authorized by NASA) for transmission of commands or data relevant to the Challenges.

Rule 7: Competitors shall permit NASA visits to Competitor's operations sites, and permit inspection of cubesats, dispensers, ground equipment and operating procedures. Visits may be used to verify compliance with the Challenge Rules.

4.5 Rules for Ground Tournament

As specified in the Rules below, GT scores are based on judges assessment of each Competitor Team's compliance to specific Challenge Rules and SLS Interface Requirements, and assessment of mission success probability for meeting the minimum requirements for either (or both) the In-space Prizes (depending on which In-space Prize(s) the Competitor Team indicates they intend to enter).

4.5.1 Ground Tournament Constraints

Any Competitor Team may participate in any or all of the Ground Tournaments (GTs). To participate in any GT, it is not necessary to have competed in the previous GTs. For example, a

Competitor Team is not required to have participated in GT1, 2, or 3 in order to participate in GT4. However, the Competitor Team must submit their Mission Concept Registration Data Package (defined in Rule 3) at least 30 calendar days prior to their first GT in which they participate.

Judging criteria and expected degrees of design maturity advance progressively for each successive GT, and all Competitor Teams (whether they are pursuing an EM-1 spot or a third party launch) are judged by the same criteria at each GT.

Rule 8: Constraints on Ground Tournament Participation

Rule 8.A: Registered Competitor Teams may participate in any, or all, of the Ground Tournaments (GT). Competitor Teams that arrange for independent, third-party launches may, but are not required to, participate in any GT. They will be judged by the same standards for probability of mission success, and compliance to specific Challenge Rules and SLS Interface Requirements as those Competitor Teams that intend to launch on EM-1.

Rule 8.B: Competitor Teams shall submit a Mission Concept Registration Data Package (defined in Rule 3) at least 30 calendar days prior to participating in their first GT.

Rule 8.C: Before each GT, Competitor Teams shall declare whether they intend to compete in either the Deep Space Derby or the Lunar Derby or both. Competitors may change their declaration prior to each GT. These declarations may be made publicly available on the Challenge website.

Rule 8.D: Prior to each GT, Competitor Teams shall declare their intention to compete for integration and launch on EM-1, or their intention to arrange for their own independent, third-party launch. Competitors may change their declaration until GT4 at which point they must make a final declaration. These declarations may be made publicly available on the Challenge website.

Rule 8.E: Competitors shall participate in at least GT4 to be considered for selection as a secondary payload on the EM-1 launch.

4.5.2 Procedures and Judging for Ground Tournament

Ground Tournaments (GTs) 1 and 2 will be conducted by teleconference. GT3 and GT4 will be conducted over a 2-day (business day) interval, on-site at Marshall Space Flight Center. GTs will be approximately three hours duration for each Competitor Team. Judges will consult with a NASA design center and/or third-party experts, and run mission simulations and analysis using product specifications and performance projections submitted by each Competitor Team 30 calendar days prior to GT. Judges will provide scores to Competitor Teams using standardized criteria, based on a scale of 1 (low, poor) to 5 (high, superb). A score of zero will be given for elements in which insufficient or no data was submitted. Judges will provide scores to Competitor Teams within two weeks of their GT.

Rule 9: Ground Tournament Judging

Rule 9.A: For each GT, Competitors shall submit required documents and data as listed on the Judges Score Card, at least 30 calendar days in advance of each GT. (The Mission Concept Registration Data Package defined in Rule 3, must be

submitted at least 30 calendar days prior to a Competitor Team's first GT, in addition to documents and data listed on the Judges Score Card.) GT judging templates will be provided in advance to the Competitor Teams.

Rule 9.B: Competitors shall permit Judges, or designee, (upon request) to conduct site inspections, inspections of competition hardware and/or software, and allow component or subsystem tests witnessing in order to verify submitted documentation.

Rule 9.C: Competitor Teams shall allow their composite scores to be posted on the Challenge website after each GT. (Competitor Team technical Intellectual Property will not be publicly released.)

Rule 9.D: All Competitor Teams shall be judged by the same criteria at each GT for (1) probability of mission success, and (2) compliance with specific Challenge Rules and with SLS Interface Requirements (even if they intend to launch on a vehicle other than the SLS.)

Rule 9.E: For each GT, 40% of each Competitor Team's assigned total score will be determined by the probability of mission success using the Judge's Scorecard.

Rule 9.F: For each GT, 60% of each Competitor Team's assigned total score will be determined by compliance to specific Challenge Rules and SLS Interface Requirements as defined in the SLS SPUG and SLS Secondary Payload Deployment System IDRD.

4.5.2.1 Rules and Requirements for GT1 Competition

Judges will provide Competitor Team scores based on standardized assessments. Every Competitor Team (up to maximum of 5 Competitor Teams) whose composite score is greater than 3.0 will be awarded $20,000 each; however if more than 5 Competitor Teams score greater than 3.0 (composite score), only the 5 highest scoring Competitor Teams will be awarded $20,000 each.

Rule 10: To participate in the GT1 and be eligible for GT1 Prize Awards, Competitor Teams shall provide to NASA the input listed on the Judges Score Card.

4.5.2.2 Rules and Requirements for GT2 Competition

Judges will provide Competitor Team scores based on standardized assessments. Every Competitor Team (up to maximum of 5 Competitor Teams) whose composite score is greater than 3.0 will be awarded $30,000 each; however if more than 5 Competitor Teams score greater than 3.0 (composite score), only the 5 highest scoring Competitor Teams will be awarded $30,000 each.

Rule 11: To participate in the GT2 and be eligible for GT2 Prize Awards, Competitor Teams shall provide to NASA the input listed on the Judges Score Card.

4.5.2.3 Rules and Requirements for GT3 Competition

Judges will provide Competitor Team scores based on standardized assessments. Every Competitor Team (up to maximum of 5 Competitor Teams) whose composite score is greater

than 3.0 will be awarded $30,000 each; however if more than 5 Competitor Teams score greater than 3.0 (composite score), only the 5 highest scoring Competitor Teams will be awarded $30,000 each

Rule 12: To participate in the GT3 and be eligible for GT3 Prize Awards, Competitor Teams shall provide to NASA the input listed on the Judges Score Card.

4.5.2.4 Rules and Requirements for GT4 Competition

The GT4 is the final ground competition. GT4 assesses which Competitor Team(s) is(are) likely to deliver a CubeSat system that can meet minimum requirements to qualify for a prize, while also meeting specific Challenge Rules and SLS interface requirements. Participation in GT4 is required for all Competitor Teams requesting integration and launch on EM-1. Judges will evaluate the CubeSat and mission design for selection as an EM-1 secondary payload based on the Judges Score Card. Every Competitor Team (up to maximum of 5 Competitor Teams) whose composite score is greater than 3.0 will be awarded $20,000 each; however if more than 5 Competitor Teams score greater than 3.0 (composite score), only the 5 highest scoring Competitor Teams will be awarded $20,000 each.

Rule 13: GT4 Rules and Requirements

Rule 13.A: Prior to GT4, Competitor Teams must declare their final intention to compete for selection to launch on EM-1, or their intention to arrange for their own third-party launch. Competitor Teams must also declare their final intention to compete in the Deep Space Derby, or the Lunar Derby, or both.

Rule 13.B: To participate in the GT4 and be eligible for GT4 Prize Awards, and to be eligible for selection, integration, and deployment on EM-1, Competitor Teams shall provide to NASA the input listed on the Judges Score Card

Rule 13.C: Only Competitor Teams that receive a GT4 score of at least 3 and are in compliance with specific Challenge requirements and Space Launch System Secondary Payload Deployment System Interface Definition and Requirements Document (IDRD) requirements will be qualified for integration, launch, and deployment on EM-1.

Rule 13.D: Only those Competitor Teams that declared, prior to entry to GT4, their intention to launch on EM-1 (and meet Rule 13.C) are eligible to launch on EM-1.

4.5.3 Down Select Launch Candidates (conditional)

Rule 14: In the event that the total number of qualified CubeSats exceeds the available EM-1 secondary payload slots allocated for these Challenges, then the following down-select Rules shall apply:

Rule 14.A: Judges shall rank all Competitor Teams in order based on the GT4 total score. In case of a tie, the tie breaker will be the highest cumulative score across all GTs.

Rule 14.B: As of this document release, the top three ranked Competitor Teams shall be selected for EM-1 integration. Additional opportunity slots will be announced, if and when they become available.

Rule 14.C: The GT4 total score ranking will be used to select backfill Competitor Teams ("runners up") in the event that any EM-1 selected Competitor Team cannot deliver their CubeSat for vehicle integration. "Runners up" should be prepared (at a moment's notice) to replace any selected Competitor Team up until actual vehicle integration date.

4.6 General Rules Applicable to Both In-Space Challenges

Rule 15: In-Space Competition Start ("Start of Competition")

Rule 15.A: Competitors that have arranged their own third party launches shall notify Judges within one day of their deployment confirmation receipt. The positive deployment confirmation time shall be considered the start time of the first competition day of their respective "Start of Competition".

Rule 15.B: For Competitors with CubeSats deployed from EM-1, the positive deployment confirmation time shall be considered the start of the first competition day for all Competitor Teams with CubeSats deployed from EM-1. (Note that the SLS Payload User's Guide and/or the SLS Secondary Payload Deployment System Interface Definition and Requirements Document may specify a timed delay before CubeSats may begin powered operation after the deployment from the SLS. Nevertheless, the deployment confirmation time shall be considered the "Start of Competition" for CubeSats deployed from EM-1.) In support, NASA will notify Competitors within one day of their successful deployment from EM-1 SLS.

Rule 16: Competitor Ground Stations

Rule 16.A: Competitor Teams may communicate with, and update, their CubeSat as often as desired within the competition period. This includes commands, revised operating instructions, software updates, etc.

Rule 16.B: Earth-based transmissions and receptions may be performed from the same ground station or differing ground stations.

Rule 16.C: Competitor Teams may not use Government controlled stations as their primary data communications stations for the purposes of communications achievements eligible for in-space Prizes, unless appropriate compensation is provided and the station is also made available under the same terms to all Competitors.

Rule 16.D: Competitor Teams will not be charged for communications monitoring by Government-controlled stations strictly for the purpose of authenticating claimed communications distances, or for verifying the achievement and maintenance of lunar orbit. See *Required Navigation Artifacts for Authenticating Claimed Comm Distances and Verifying Achievement and Maintenance of Lunar Orbit.*

Rule 16.E: Ground station operators may be Team Members (Rules 1 and 2 apply), or ground station services or facilities may be procured by the Competitor Team (Rules 1 and 2 do not apply, except for Rule 1.C).

Rule 17: Planetary Protection

Rule 17.A: Competitor Teams shall submit Orbital Debris Assessment Reports (ODARs) and End of Mission Plans (EOMPs) that are compliant with NASA-STD-8719.14 *Process for Eliminating Orbital Debris*, in order to be compliant with U.S. National Space Policy of the United States of America (June 2010), the U.S. Government Orbital Debris Mitigation Standard Practices (February 2001), and other National and International policies and guidelines for limiting Earth-orbiting debris.

Rule 17.B: Competitor Teams shall submit their ODARs and EOMPs to Judges no later than Ground Tournament 4.

Rule 17.C: Competitor Teams with CubeSats that enter lunar orbit shall submit an End of Mission Plan that, to the satisfaction of Judges, complies with "NASA's Recommendations to Space-Faring Entities: How to Protect and Preserve the Historic and Scientific Value of U.S. Government Lunar Artifacts" found at http://www.nasa.gov/sites/default/files/617743main_NASA-USG_LUNAR_HISTORIC_SITES_RevA-508.pdf

Rule 17.D: Competitor Team mission designs must be compliant with requirements of NPR 8020.12 *Planetary Protection Provisions for Robotic Extraterrestrial Missions*. For Competitor Teams that demonstrate to the satisfaction of Judges (by trajectory simulation/analysis or other documentation) that their CubeSats will not encounter any protected planet (beyond Earth and Earth's moon), then written documentation compliant with NPR 8020.12 is the only requirement for planetary protection. (Tests and demonstrations would not be required.)

Rule 17.E: Competitor Teams shall submit a letter to Judges explaining their planetary protection plan at GT1. Competitor Teams shall submit their final planetary protection plan at GT4. Competitor Teams shall submit a Pre-launch report for purposes of compliance with NPR 8020.12 at L-60 calendar days. Competitor Teams shall submit a post-launch report at L+60 calendar days. Competitor Teams shall submit an EOMP at mission end.

Rule 18: Communications Competition Procedure for Both In-Space Challenges.

The exact details of the implementation of the following Rules are contained in the supplemental document *Communications Procedure for Both In-Space Challenges* (*CommsProc*).

Rule 18.A: Each Competitor Team shall inform Judges a minimum of 24 hours prior to the start of each operating period (as specified in *CommsProc*). If the Competitor Team does not announce operating periods, then Judges will not consider any operations that day for competition purposes.

Rule 18.B: Competitor Teams shall generate their random data using the algorithms and protocols specified in *CommsProc.* Judges will not accept data generated by any other methodology.

Rule 18.C: The Competitor Team shall supply a CubeSat communications log to the Judges to verify competition timing.

Rule 18.D: Competitor Teams may choose to wrap data blocks in a convenient protocol for transmission to assist with block accounting and sequencing as long as the Judges can verify that data were generated by the prescribed algorithm.

Rule 18.E: The Competitor Team shall receive the data blocks over the communications link, perform any required error correction deemed necessary, and arrange the blocks in correct sequence. Any blocks that are not completely received within the operating period will not count towards the operating period total.

Rule 18.F: The Competitor Team shall deliver to NASA properly sequenced, unique (nonduplicative) error-free data blocks received at the ground station(s) within 10 minutes of the operating period closure. If the Competitor Team requires a data retransmission to achieve an error-free block, the Competitor Team must complete that transaction by the end of the operating period.

Rule 18.G: As specified in *CommsProc*, the Competitor Team shall provide the evidence that authenticates actual transmission achievement from their spacecraft in space and ground station receipt to the Judges. The Competitor Team shall make raw data available to the Judges at the same time as the Competitor Team presents the sequenced data. Judges shall also receive contact logs from the ground station operators. Logs are to include (at minimum) pointing data, AZ/EL coordinates, and receiver start/stop times. Competitor Teams shall provide documented Rule 19.G compliance procedures before GT3.

Rule 19: Competition End for Both In-Space Challenges ("End of Competition")

Rule 19.A: For Competitor Teams that have arranged their own third party launch, all activities for the purposes of these Challenges shall end exactly 365 competition days after their respective CubeSat deployment confirmation time, or exactly 365 competition days after the EM-1 deployment confirmation time, *whichever occurs first*.

Rule 19.B: For Competitor Teams deployed on EM-1, all activities for the purposes of these Challenges end exactly 365 competition days after the EM-1 deployment confirmation time.

Rule 19.C: No activity taking place later than exactly 365 competition days after the EM-1 CubeSat deployment shall be counted for Challenge purposes, regardless of the respective launch dates.

Rule 19.D: For Competitor Teams that have arranged their own third party launch, data transmissions after 365 calendar days will only be used for longevity category entrants regardless of data burst rate or data aggregate volume. Data transmissions must meet minimum requirements based on the prize.

Rule 20: If, for any reason, a CubeSat does not successfully deploy from EM-1 (a dispenser malfunction, for example), then that Competitor Team shall be ineligible for any In-space Prizes.

Rule 21: Competitor Teams shall acknowledge that NASA reserves the right to share information about Competitor Team accomplishments and progress, after verification by Judges, throughout the Challenge period. Accomplishment or progress information may include, for example, the data volumes communicated, time of lunar orbit, and cubesat distances from Earth. NASA also reserves the right to publicly announce when Competitor Teams are planning to attempt a communications task or propulsion maneuver before results have been confirmed by Judges.

4.7 Additional Rules for Deep Space Derby

Rule 22: Achievement and Maintenance of Verifiable Minimum Required Distance from Earth

Rule 22.A: Competitor CubeSats shall achieve and maintain a verifiable minimum required distance from Earth's surface of at least 4,000,000 kilometers (+/- 4,000 km allowable tolerance) during any operations that would count toward the Deep Space Derby Prizes achievements.

Rule 22.B: Competitors shall provide evidence that demonstrates, to the Judges' satisfaction, the spacecraft distance from Earth. (Acceptable evidence to be submitted to NASA for purposes of authenticating the claimed distance from Earth is specified in *Required Navigation Artifacts for Authenticating Claimed Comm Distances and Verifying Achievement and Maintenance of Lunar Orbit*, a separate document.)

Rule 22.C: In the event that no CubeSat successfully reaches the minimum distance from Earth (Rule 22.A) within 365 competition days of the EM-1 launch, NASA will declare the Deep Space Derby over with no winner and no prizes awarded.

Rule 23: Deep Space Derby Prizes

Rule 23.A: **Best Burst Data Rate:** $225,000 will be awarded to the Competitor Team that receives the largest, and $25,000 will be awarded to the Competitor Team that receives the second largest, cumulative volume of error-free data (above the minimum volume of **one** 1024 bit data block) from their CubeSat over a 30-minute period while satisfying Challenge Rules and definitions. If only one Competitor Team achieves more than the minimum volume, they are awarded $250,000. If no Competitor Team achieves more than the minimum volume, no Best Burst Data Rate prize will be awarded. In case of a tie, all qualifying tied Competitor Teams will receive an equal portion of this prize amount.

Rule 23.B: **Largest Aggregate Data Volume Sustained Over Time**: $675,000 will be awarded to the Competitor Team that receives the largest, $75,000 will be awarded to the Competitor Team that receives the second largest, cumulative volume of error free data (above the minimum volume of **one thousand** 1024 bit data blocks) from their CubeSat over their best contiguous 28-day (calendar days) period while satisfying Challenge Rules and definitions. If only one Competitor Team achieves more than the minimum volume, they are awarded $750,000. If no Competitor Team achieves more than the minimum volume, no Largest Aggregate Data Volume prize will be awarded. In case of a tie, all qualifying tied Competitor Teams will receive an equal portion of this prize amount.

Rule 23.C: **Spacecraft Longevity**: $225,000 will be awarded to the Competitor Team with the longest elapsed number of competition days, and $25,000 will be awarded to the Competitor Team with the second longest elapsed number of competition days, between the date of their first and last, confirmed reception of error-free, 1024-bit data blocks from their CubeSat while maintaining at least the minimum required distance from Earth, and before the "End of Competition" (above the minimum number of 28 elapsed competition days) while satisfying Challenge Rules and definitions. If only one Competitor Team achieves more than the minimum number of 28 elapsed competition days, they are awarded $250,000. If no Competitor Team achieves more than the minimum number of 28 competition days, no Longevity Contest prize will be awarded. In case of a tie, all qualifying tied Competitor Teams will receive an equal portion of this prize amount.

Rule 23.D: **Farthest Communication Distance From Earth**: $225,000 will be awarded to the Competitor Team that receives from the CubeSat at least one, error-free, 1024-bit data block, from the greatest, and $25,000 will be awarded to the Competitor Team with the second greatest distance from Earth (above the minimum distance of 4,000,000 km), and before the "End of Competition", while satisfying Challenge Rules and definitions. If only one Competitor Team receives at least one, error-free 1024-bit data block (above the minimum distance of 4,000,000 km from Earth), they are awarded $250,000. If no Competitor Team receives data, no Farthest Communication Distance prize will be awarded. In case of a tie, all qualifying tied Competitor Teams will receive an equal portion of this prize amount.

4.8 Additional Rules for Lunar Derby

Rule 24: Achievement and Maintenance of Verifiable Lunar Orbit

Rule 24.A: Competitor CubeSats shall achieve and maintain a verifiable lunar orbit, during any operation that would count towards the Lunar Derby Prizes achievements.

Rule 24.B: For the purpose of the Lunar Derby, a lunar orbit is defined as at least one complete orbit of minimum distance always above the lunar surface of 300 km, and with an aposelene that never exceeds 10,000 km.

Rule 24.C: Competitors shall provide evidence, to the Judge's satisfaction, that demonstrates that they have successfully achieved a lunar orbit, as defined in Rule 24.B. (Acceptable evidence to be submitted to NASA for purposes of authenticating claimed lunar orbit is specified in *Required Navigation Artifacts for Authenticating Claimed Comm Distances and Verifying Achievement and Maintenance of Lunar Orbit,* a separate document.)

Rule 24.D: Competitor Teams shall provide evidence demonstrating their CubeSat has maintained a minimum altitude of at least 300 km above the lunar surface at all times, before intentional end-of-mission disposal maneuvers.

Rule 24.E: Competitor Teams shall provide evidence, to the Judge's satisfaction, demonstrating that their CubeSats has maintained a lunar orbit (as defined in Rule 24.B) during any operations counting towards competition achievements or prize awards.

Rule 24.F: In the event that no CubeSat successfully achieves verifiable lunar orbit (as defined in Rule 24.B) within their respective 365-day (calendar days) competition, NASA will declare the Lunar Derby competition over with no winner and no prizes awarded.

Rule 25: Lunar Derby Prizes

Rule 25.A: **Lunar Propulsion**: All contestant Competitor Teams that successfully demonstrate their CubeSat has achieved at least one verifiable lunar orbit and satisfy Challenge Rules and definitions shall be awarded an equal share of the $1,500,000 Lunar Propulsion Competition Prize, with a maximum of $1,000,000 to any one Competitor Team.

Rule 25.B: **Best Burst Data Rate:** $225,000 will be awarded to the Competitor Team that receives the largest, and $25,000 will be awarded to the Competitor Team that receives the second largest, cumulative volume of error-free data (above a minimum volume of **one** 1024 bit data block) from their CubeSat over their best 30-minute operating period while satisfying Challenge Rules and definitions. If only one Competitor Team achieves more than the minimum volume, they will be awarded $250,000. If no Competitor Team achieves more than the minimum volume, no Burst Data Rate prize will be awarded. In case of a tie, all qualifying tied Competitor Teams will receive an equal portion of this prize amount.

Rule 25.C: **Largest Aggregate Data Volume Sustained Over Time**: $675,000 will be awarded to the Competitor Team that receives the largest, $75,000 will be awarded to the Competitor Team that receives the second largest, cumulative volume of error free data (above a minimum volume of **one thousand** 1024 bit data blocks) from their CubeSat over their best contiguous 28-day (calendar day) period while satisfying Challenge Rules and definitions. If only one Competitor Team achieves more than the minimum volume, they will be awarded $250,000. If no Competitor Team achieves more than the minimum volume, no Aggregate Data Volume prize will be awarded. In case of a tie, all qualifying tied Competitor Teams will receive an equal portion of this prize amount.

Rule 25.D: **Spacecraft Longevity Contest:** $450,000 will be awarded to the Competitor Team that achieve the longest elapsed number of competition days between the first and last confirmed reception (greater than a minimum number of 28 elapsed competition days), and $50,000 will be awarded to the Competitor Team with the second longest elapsed number of competition days, of an error-free, 1024-bit data block from their CubeSat while satisfying Challenge Rules and definitions. If only one Competitor Team achieves more than the minimum number of 28 elapsed competition days, they will be awarded $500,000. If no Competitor Team achieves more than the minimum number of competition days, no Longevity Contest prize will be awarded. In case of a tie, all qualifying tied Competitor Teams will receive an equal portion of this prize amount.

4.9 Additional Cube Quest Challenge Rules

Rule 26: The Centennial Challenge Program (CCP) has made significant effort to develop fair and just competition rules. In the event that the CCP deems it necessary, additional rules or requirements may be administered with the concurrence of all currently registered Competition Team(s). Failure to adopt or follow such additional rules or requirements shall be grounds to terminate a Competition Team and all Team Members from the Challenge.

5.0 DATA SUBMISSION

5.1 Format

All Challenge document submissions shall be written in Helvetica font style with minimum 12 point font size. Challenge presentations, such as Ground Tournament, may use either Helvetica or Garamond font style with minimum 14 point font size. Arial is a suitable substitute when Helvetica or Garamond font styles are not available.

Document and presentation submissions shall be in Adobe portable document format (pdf). Microsoft Word and PowerPoint are suitable substitutes when pdf is not available.

Hand written or drawn documents shall be scanned into Adobe pdf with minimum 400x400 dots per inch (dpi).

5.2 Method

All Challenge submissions shall be sent to the Cube Quest Challenge email address: ARC-cubequestchallenge@mail.nasa.gov

Submitted documents will be routed to appropriate points of contact (Judges, Subject Matter Experts, etc.) At no point will Competitor Team Intellectual Property (IP) be passed to anyone not involved with Challenge administration.

5.3 Registration Data Package

Registering Competitor Teams must provide the following items to be considered for prizes in the Cube Quest Challenge:

1. Competitor Team Name
2. Competitor Team affiliation or sponsoring company/organization
3. Team Leader Designation
4. Team Leader Proof of U.S. Citizenship or Permanent Residence
5. Company/organization proof of U.S. incorporation and address of operations (if applicable)
6. List of Team Members and appropriate proof of eligibility (if applicable)
7. All appropriate Competitor Team contact information (phone number, email address, website links) to coordinate reviews, rules verifications, site visits, or other necessary forms of correspondence.
8. Proof of Liability Coverage (Rule 2.C)
9. Acknowledgement to rules compliance. Any violation of rules is subject to review and possible removal from the Challenge. All Team Members must submit the following statement with his/her signature.

> I have read and will comply with the Cube Quest Challenge rules. I acknowledge that I satisfy the necessary requirements for challenge participation. Any

misrepresentation of myself will result in Competitor Team disqualification. I also acknowledge that NASA will only disperse awarded prizes to the Team Leader and not to individual Team Members.

Appendix A - Acronyms and Abbreviations

cm	centimeter
CY	Calendar Year, January to December
dpi	dots per inch
EM	Exploration Mission
FY	Fiscal Year, October to September
GT	Ground Tournament
GRC	Glenn Research Center
GSE	Ground Support Equipment
GSFC	Goddard Space Flight Center
ICD	Interface Control Document
IDD	Interface Definition Document
IDRD	Interface Definition and Requirements Document
kg	kilogram
km	kilometer
KPP	Key Performance Parameters
KSC	Kennedy Space Center
MAF	Michoud Assembly Facility
MPCV	Multi-Purpose Crew Vehicle
MSA	MPCV Spacecraft Adapter
MSFC	Marshall Space Flight Center
NASA	National Aeronautical and Space Administration
pdf	portable document format
RF	Radio Frequency
SLS	Space Launch System
SPDS	Secondary Payload Deployment System
SPIM	Secondary Payload Integration Manager
SPUG	Secondary Payload Users Guide
SRD	System (Subsystem) Requirement Document
SSC	Stennis Space Center
TLI	Trans-Lunar Injection
U	Satellite unit of measure, 1 U = 10 cm x 10 cm x 10 cm (cubic volume)
VAB	Vehicle Assembly Building
W	Watt

REFERENCES

1. None